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AUTHOR Gindele, John F.; Gindele, Joseph G.
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ABSTRACT

Arguing that videodisc technology has major implications for the storage and retrieval of information and that it may meet learners' needs in ways never before possible, this paper highlights key points regarding the history and development of videodisc technology, explores its implications for education, and addresses current and future uses of the technology. A review of the development of the videodisc covers: what a videodisc system is; history of the videodisc; technological developments; types of systems (capacitance and optical); features such as recording and storage capabilities; costs; and advantages and disadvantages of videodiscs. A discussion of uses of videodisc technology concentrates primarily on educational applications, and a few comments on the future of videodisc technologies conclude the paper. A list of references is included. (THC)

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Interactive Videodisc Technology and its Implications for Education

by

John F. Gindele, M.S.
Joseph G. Gindele, M.S.
Graduate Teaching Assistants
and Doctoral Candidates

Industrial Technology Department
College of Natural Sciences
University of Northern Iowa
Cedar Falls, Iowa

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According to Naisbitt (1982), Toffler (1980), and others, the "information age" society has arrived. Technological developments as related to the handling of information are occurring so rapidly that trying to keep up with such changes is becoming increasingly difficult. Educators should make every effort to understand and attempt to utilize these technologies in order to better manage the tremendous amount of new information that is constantly evolving.

One recently developed technology, the videodisc, seems to have major implications in the storage and retrieval of information and it may be able to meet the learner's needs in ways never before possible. Wood and Woolley (1980) report that when a videodisc is combined with other technologies it can form a " . . . major library information delivery system" (p. 19). McClain (1983) asserts that: "Just as movable type spread literacy throughout the world, so commercial videodisc technology promises to radically change the way we share information" (p. 79).

This paper will highlight some of the key points regarding the history and development of videodisc technology and the profound implications it may have for education. Present and future uses of the technology will also be addressed.

Development of the Videodisc

What is a Videodisc?

A videodisc is a storage medium which very much resembles a phonograph record. Negroponte of M.I.T. says: "We can think of the disc as point of convergence for all media" (Sneed, 1980, p. 186). "It is not simply a videotape on a disc" (Wood and Woolley, 1980, p. 2). It can

store visual material, binary data, and audio, and rapidly retrieve such information for playback through a television monitor. Clement (1981) suggests the most versatile disc allows these formats to be combined.

History of the Videodisc

Although videodiscs have been on the market for several years, they are not new. John Baird first invented them in England in 1927. At that time he recorded a television picture on 78 rpm records (Video, 1970). The next break came in the 1960's when the technology was further developed and then in 1978 when these discs and systems were marketed in the United States.

Of the dozen or more companies which have been developing this technology, Bejar (1982) lists three companies which have recently emerged as top competitors in the United States market. They are: (1) Phillips/ Music Corporation of America (MCA®), (2) RCA®, and (3) the Japan Victor Companies (JVC®). Durniak (1979) and Sneed (1980) list cooperative efforts between the U.S. and foreign manufacturers in videodisc development. IBM® and MCA®, RCA® and Zenith®, and G.E.® and JVC®, have established joint ventures in this endeavor.

Technological Developments

What is a Videodisc System? A videodisc system consists of a prerecorded vinyl videodisc, a videodisc player, and a television monitor. Presently, the public can only retrieve data from a videodisc, they cannot record on it (Smith, 1978). A recordable disc, however, should become a reality by the middle of this decade (Butler, 1981), and in five to eight years be available and priced for home use (Hughey, 1983). The potential of such a system to the educational and training and

development community may be greatly enhanced with the addition of a microcomputer, making such a system truly interactive.

Types of Systems. There are basically two types of videodisc systems: (1) Capacitance, and (2) Optical. The Capacitance (mechanical) System also comes in two types. The first is called the Capacitance Electronic Device (CED) which uses a stylus and a movable arm to read the information. RCA®, Sanyo®, Toshiba®, and others, manufacture this type. The other type is a grooveless system known as Video High Density (VHD). With the CED system, data is recorded in oblong "micropits" in the 12 miles of microgrooves on the videodisc's surface (Ingraham, 1980). According to Ciarcia (1982), each groove is 1/38 the width of a groove of a standard audio disc. These discs tend to wear out in time due to the physical contact between the stylus and the disc's surface. The surface of the CED disc has a thin metallic coating and the metallic portion of the stylus converts these "pits" into varying capacitances which then become audio and video signals. Each disc of this type is enclosed in a protective jacket since it can be easily damaged by scratches and fingerprints. Both of these types may only be read linearly (from beginning to end) and lend themselves more to home entertainment system use.

Optical systems generally employ the use of laser technology to read the data. Since these discs are grooveless and are read by a programmed laser beam, they are best used with, and controlled by, a microcomputer (Gold, 1982). Because there is no stylus, no physical contact is made, therefore no wear occurs to the disc's surface. Optical discs are not sensitive to scratches or fingerprints and do not require a

protective jacket. These discs appear iridescent and silver-colored.

Optical Systems also come in two types: (1) Reflective and (2) Transmissive. Reflective discs, made by Sony®, 3M®, Pioneer®, and others, retrieve information from only one side of the disc, after which the disc must be turned over if the other side is to be read. This problem is eliminated by the use of the transmissive disc, such as those manufactured by Thomsen-CSF®, which allows the laser beam to read one surface of the disc, after which the beam is automatically re-focused through the disc to read the other side. With the optical system, high density reflections from the micropits are read by the laser beam and this information is then converted by the player into audio and/or video signals and displayed on the television monitor.

Optical systems, although expensive, are very versatile. Because data can be read non-linearly, information from any one of the 54,000 tracks, frames, or "pages" per side can be retrieved rapidly, and in any order. This is not possible with the capicitance disc (or video-tape, for that matter) which must be read linearly. Optical discs, therefore, are suitable for interactive learning where branching within the instructional program may take place and where the user may view any of the material in any order (Paris and Boss, 1982). A program, therefore, may have many beginnings, middles and ends, for true individualization (Kemph, 1981). This feature plays a major part in training and development programs and a computer-driven optical system may have a profound effect on the way people learn.

Features-Recording and Storage Capabilities. Free (1981) suggests that optical laser videodiscs have the densest storage medium yet de-

vised. Wood and Woolley (1980) concur and further state that this technology surpasses " . . . existing storage media, including the magnetic computer discs with more than 13 billion bits (gigabits) of information" (p. 5). One billion characters would be enough to store all of the telephone directories for the country's 100 largest cities (Marcum and Boss, 1981). Clement (1981) reports that by the 1990's, 10,000 billion (10 trillion) bits of storage per side will be possible. It is interesting to note that all the books in the Library of Congress could be recorded on 100 optical discs (Bensinger, 1981), taking up a space of approximately two cubic feet.

Other storage formats include audio (tapes, cassettes, phonograph records), and visuals (television, videotapes, motion pictures, filmstrips, slides, film loops, overhead transparencies, microforms, textbooks, dictionaries and encyclopedias). With 108,000 pictures per disc (both sides), Free (1981) suggests that if one watched one picture per second, one would need 30 hours to see them all. Clement (1981) states that " . . . the entire text of the Encyclopedia Britannica [30 Volumes] can be stored on merely four percent of a disc's surface" (p. 12). In addition, textbooks, reformatted to fit television's 3:4 concept ratio, would mean that both sides of a disc can store the equivalent of 540 200-page or 360 300-page textbooks (Sneed, 1980), or 1350 80-slide carousel trays (Kindleberger, 1982), 600 feet of sound 16mm film, or 400 hours of stereo sound (Wood and Woolley, 1980).

Costs. How expensive are these systems? A capacitance system costs between $350-$400 (Bensinger, 1981; McClain, 1983), while an optical system for the home costs about $700 (Kindleberger, 1982; McClain, 1983).

Industrial education models with a computer interface costs approximately $2500-$4500 (Fletcher, 1979) and elaborate and sophisticated optical industrial videodisc systems cost from $40,000 to $100,000 each (Bensinger, 1981). McClain (1983) says " . . . it takes 20 weeks--from original concept to mastering--to produce a videodisc" (p. 80), and " . . . some discs cost as much as $100,000 per side to produce" (Wollman, 1983, p. 81). Although the manufacture of master optical discs are expensive (they require more complex technology), the more discs produced and sold, the less the unit price (Bensinger, 1981). Capacitance disc production requires a more simpler technology and is therefore less expensive to manufacture. Magarrell (1977) notes that it costs about 60 cents to manufacture each disc from the master because each can be copied the same way as audio records--via the stamping process. In fact, Bensinger (1981) reports that 35 discs can be produced from one pound of polyvinyl chloride at $1.50 per pound. These discs will then retail for $10 to $20 each--less expensive than videotape, which according to Evans (1975) and McClain (1983), should also decrease pirating.

Advantages of Videodiscs. Videodiscs can store multiple media formats within all of the 54,000 frames per side. Since each frame is numbered, information can be easily accessed on an optical disc in 2-3 seconds, versus videotape access of 20-100 seconds (Fletcher, 1979), and the visual resolution of each frame is excellent. Butler (1981) believes that the resolution has the potential of being six times as dense as the video of today. The color of visuals stored on a videodisc does not fade as it does with film (Clement, 1981). Cook (1980), Love (1979),

and Zuckerman (1981) all agree that the sound is brilliant--even better than stereo. Over 400 million dollars have already been spent in research and development of laser audio discs. Videodiscs are more rugged than videotape or film, and discs are easier to duplicate and less costly to produce (Ingraham, 1980; Withrow and Roberts, 1982; Zuckerman, 1981).

Disadvantages of Videodiscs. Presently there are some shortcomings of videodisc technology: (1) It is difficult to develop effective interactive software and there is a critical need for more technical instructional developers in this area (Fletcher, 1979; Robson, 1976). (2) Producing a limited number of discs is expensive, as is the initial cost of players (Heuston, 1977). (3) The selection of interactive discs are limited (Berger, 1981). (4) Revisions mean remastering the original disc (Cook, 1980). (5) Presently, the disc cannot be recorded by individuals in the home--it is only a playback medium (Cook, 1980; Heuston, 1977), but in time this should change (Fletcher, 1979; Hughey, 1983).

Uses of Videodisc Technology

Wollman (1983) suggests that videodiscs may find uses in basically five categories: (1) demonstration/self-help, (2) job training, (3) education, (4) data archives, and (5) data replication. Each can increase productivity and/or achieve cost benefits upon application.

The primary use of videodiscs up to the present time has been for home entertainment, in the form of long-run feature movies. When wired to a microcomputer, the videodisc system changes from a passive to a truly interactive technology. Marcum and Boss (1981) suggest that this new marriage of information technologies (videodisc, videodisc player,

microcomputer, and television monitor) is beginning to have major implications in education and industrial training and development programs.

Heuston (1977) describes the three most important technologies that education has attempted to harness--the book, the motion picture (television), and the computer. Each has its strengths and weaknesses. Heuston (1977) reports that the videodisc, when interfaced with a microcomputer, offers a combination of the strengths of these three technologies--excellent presentation format and excellent learner productivity (random access of audio and visual material, motion, freeze-frame capabilities, interactivity)--without any of the weaknesses of the book (limited interactivity, lack of sound and motion, print literacy and user motivation requirement); television (linear presentation, inability to freeze a frame or give trials with feedback, passive system); computer (limited audio and quality presentation format, motion pictures and photography). Daynes (1976) also concurs that "interactivity" is a major strength of the optical system.

Features of optical videodisc systems include automatic frame recall and stop (to study a process or concept as long as needed), dual audio tracks allowing for one or two languages, or remedial/basic or basic/gifted instruction, adjustable forward/reverse, speed control as well as the capability to freeze a frame for closer study. These features work in unison to increase learner productivity because the learner interacts with material at his/her own pace and generally at a time of his/her own choosing for study, review, or enrichment. Robson (1976) believes this technology may have more patience than any human.

A few ways in which interactive videodisc technology will assist

the instructor was cited by Heuston (1977): (1) It can present accurate material at an appropriate level for each student, and (2) can give trials with immediate and appropriate feedback. Reinforcement will occur because material can be presented iteratively and in various degrees of understanding according to the ability level of the learner. (3) Motivation and encouragement will occur because students will learn at their own pace and with a one-to-one relationship with the computer and monitor, without group evaluation and judgement. Gold (1982) believes that attention spans of individuals will increase and motivation will rise as a result of this interaction. Fletcher (1979) and Kleinberg (1981) indicate that the most important feature of this technology is its ability to freely mix digital, audio, and photographic information in any conceivable combination--a situation unattainable in the past.

Educational uses of interactive videodisc technology are numerous. Videodiscs can be effectively used for providing Simulations (such as travel, performing dangerous tasks, and testing and developing particular skills), which allow the student to pursue the implications of his or her decisions. Archival and Reference Services will be able to store art and museum collections, maintenance and operational procedures, parts of which can be "called-up" for viewing. Reference discs incorporating two-language dictionaries, and talking encyclopedias, illustrated with moving images and sound, are possible. Testing and Record Keeping can make use of videodiscs with questions on one track, and answers on the other (Love, 1979). Foreign Language development can make use of dual audio tracks for bilingual education (Robson, 1975; Sneed, 1980). In Special Education programs, the physically limited

will have greater access to education. Closed-captioned discs for the hearing impaired are already being developed. Dual audio tracks can make the same disc useful for students with different achievement levels (Withrow and Roberts, 1982). Continuing Education programs can be placed on discs and easily mailed to people for use in correspondence courses. Off-campus education may increase while travel time and energy expended for transportation to learning centers may decrease.

Presently, dozens of research projects are underway throughout the United States. Various publishing companies, professional organizations, institutes, universities, and industries, are attempting to utilize this technology to increase productivity in education and training, or utilize it's capabilities to store digitized data.

Daynes (1976) reports that instructional effectiveness of an interactive videodisc system should have three prerequisites: (1) the system should be able to interact with the learner, (2) provide for information presentation by various media, and (3) allow for individualization of instruction. Optical videodisc technology meets all of these requirements.

What Does the Future Hold?

With any developing technology refinements are made and as more units are produced and marketed, the cost of these systems may decrease. As this occurs, more units may likely be purchased because they would be more affordable. There will continue to be a great need for development specialists to design instructional software for videodiscs (Robson, 1976). Progress is currently being made with research and development of compressed audio superimposed on still pictures (Devlin, 1982; Kind-

leberger, 1982). Kloock (1982) affirms that over one billion dollars have already been spent on research and development of videodisc technology. Kindleberger (1982) predicts that the market for such systems will be 3.2 billion dollars by 1986, and will grow to 7 billion dollars by the end of the decade.

Sarnoff (1976) contends that many applications of videodisc systems are still dreams in the minds of the developers, educators, and industrialists. The question is, will educators be ready to adapt, use, and support the development of these technologies in the classroom?

Bennion (1974) acknowledges that videodisc technology is a quantum leap forward in instructional media. Kloock (1982) concurs and further states that " . . . it will change our lives in the next decade" and this technology is " . . . so powerful that both industry executives and educators are awed by its potential" (p. 8). The interactive videodisc may become one of the most revolutionary developments in the history of entertainment, information processing, education, and training. Coupled with satellite and cable television, interactive videodisc technology, when interfaced with an international image bank, " . . . would make culture available to all and Marshall McLuhan's global village a reality" (Love, 1979, p. 89). According to Wood and Woolley (1980): "Some authorities have suggested that the impact will be equal to or greater than that of print technology some 500 years ago" (p. 2). The question is, what part will each teacher play in the use and/or development of this emerging and extremely powerful technology in the months and years ahead?

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